10. WORKSHOP 2: MBSE Practices Across the Contractual Boundary

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Abstract

Systems engineering practice is progressively migrating to Model-Based Systems Engineering (MBSE) practice as evidenced through the contributions to the DSTO MBSE Symposium (2011), INCOSE MBSE International Workshop (2012) and ongoing activities in various Australian organisations such as DSTO[5], Deep Blue Tech[6], Air Warfare Destroyer[7], Aerospace Concepts[8], Raytheon[9], and DSIC[10,11]. Furthermore, MBSE is gaining momentum within the Australian Department of Defence. In particular, the SEA 1000, LAND 400, and LAND 19 (Phase 7) projects are adopting an MBSE approach for the capability system definition.

However, to date MBSE has only been adopted on an "Ad-hoc" basis (aka "model-supported engineering"). In other words, models are used to support the system engineering activities at distinct phases, rather than being evolved and matured throughout the system lifecycle. One of the key impediments is the reliance by all parties on the use of documents at the contractual interface between the acquirer and the provider, as illustrated in **Figure 1**.
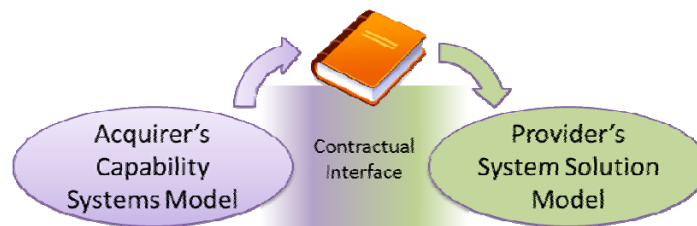

Figure 1: Contractual Interface

As a result, in the defence context, "*above-the-line*" (acquirer) capability models are required to produce a Capability Definition Document (CDD) set and other related artefacts. These

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[5] Robinson, K., et al. *Demonstrating Model-Based Systems Engineering for Specifying Complex Capability*, in Systems Engineering Test and Evaluation (SETE) 2010 Adelaide, Australia

[6] Pearce, P., *Model-Based Systems Engineering and Its Application to Submarine Design*, in Submarine Institute of Australia Science, Technology and Engineering Conference 2011, Adelaide, Australia

[7] Mays, R., *Deploying a SysML MBSE Environment - Lessons Learned from the SEA 4000 - Air Warfare Destroyer Program*, in DSTO MBSE Symposium 2011, Adelaide, Australia

[8] Harvey, D., et al., *Document the Model, Don't Model the Document*, in INCOSE International Symposium 2012, Rome, Italy

[9] Saunders, S., *Does a Model Based Systems Engineering Approach Provide Real Program Savings? - Lessons Learnt*, in DSTO MBSE Symposium 2011, Adelaide, Australia

[10] Do, Q., et al., *Requirements for a Metamodel to Facilitate Knowledge Sharing between Project Stakeholders*, in 10th Annual Conference on Systems Engineering Research (CSER 2012)2012, Missouri, US

[11] Do, Q. and S. Cook, *An MBSE Case Study and Research Challenges*, in 22nd Annual International Symposium of INCOSE2012, INCOSE, Rome, Italy

Report Documentation Page

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14. ABSTRACT
Systems engineering practice is progressively migrating to Model-Based Systems Engineering (MBSE) practice as evidenced through the contributions to the DSTO MBSE Symposium (2011), INCOSE MBSE International Workshop (2012) and ongoing activities in various Australian organisations such as DSTO5, Deep Blue Tech6, Air Warfare Destroyer7, Aerospace Concepts8, Raytheon9, and DSIC10,11. Furthermore, MBSE is gaining momentum within the Australian Department of Defence. In particular, the SEA 1000, LAND 400, and LAND 19 (Phase 7) projects are adopting an MBSE approach for the capability system definition.

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documents are then provided to potential prime contractors (providers) who then interrogate them to produce their own systems model. This is an inefficient process and there is a high likelihood of errors and unwanted artefacts being introduced into the process.

One solution would be to pass the capability system models through the contractual interface and integrate them to the provider's system solution model. In order to address this issue, the workshop aims to discuss and surface the key issues and challenges inherent in utilising a single MBSE representation in a competitive tender environment.

The workshop discussion will be limited to the Request For Tender (RFT) defence contracting model and will be focussed on the following areas (but not limited to):

1. What classes of information in the Acquirer's Capability System Model should be disclosed to the Provider?

2. What classes of information in the Provider's System Solution Model should be disclosed to the Acquirer?

3. How should the two models be interfaced?

4. Metamodels that could underpin items 1-3

5. Model-based tender evaluation by the acquirer

6. Model-based RFT evaluation by the provider

7. Legal framework and IP issues.

Facilitator Biographies

Dr Quoc Do is currently a Research Lead – MBSE, at the Defence Systems Innovation Centre (DSIC), and a Research Fellow at the Defence and Systems Institute (DASI), University of South Australia. He completed his BEng, MEng and PhD all at the University of South Australia. His research interests are in the areas: 1) systems engineering, including systems integration of COTS/MOTS components, Model-Based Systems Engineering (MBSE), systems engineering of autonomous systems, and systems of systems; and 2) domain-specific engineering research, including autonomous systems, vision systems, data fusion, artificial intelligent, agent-based modelling, and Data Distribution Services (DDS). In addition, he has been actively involving in systems engineering professional societies, and currently the Deputy President of the Systems Engineering Society of Australia (SESA), and Associate Director for Technical Review of INCOSE. He is also the Editor of the International Journal of Intelligent Defence Support Systems (IJIDSS).

Jonathan Hallett is the Systems Engineering Team Leader at Deep Blue Tech (DBT) and has over 27 years' experience in the Maritime Defence Arena.

A major focus of Jon's work at DBT involves ensuring understanding and consistency across the design team through process, practise, tools and training. Jon leads the requirements development effort within DBT working with both retired submariners and DBT's engineers. He provides both the co-ordination and interpretation of the needs of both the Operator Community and the Design Engineers to ensure that they are understood and translated into unambiguous requirements for the design team to work with.

Immediately prior to joining DBT, Jon was a Consultant to the Finnish Navy MCMV 2010 project where he supported the Navy in their requirements definition, design reviews and shipbuilder/contractor reviews leading up to and during construction of three new Mine Countermeasures Vessels.

Before this, Jon worked for QinetiQ (and its predecessors) in the Underwater Warfare area. He occupied roles such as Deputy Head of Science and Engineering – Underwater Systems, Business Group Manager – Underwater Warfare and Studies, Capability Leader – Detection Systems and Team Leader – Mine Sweeping Systems. During this time, Jon led and participated in numerous concept studies at business, platform and system level across the Underwater Warfare spectrum of activities. He was the QinetiQ Technical Representative in the UK MoD's Mine Countermeasures Equipment (MCME) IPT, Sea Division representative on the QinetiQ Systems Engineering Practitioners Forum and has represented the UK on a NATO Mine Warfare Project Group and Joint Research Programme.

Workshop Presentation and Outcomes

Background

▸ Systems engineering practice is progressively migrating to Model-Based Systems Engineering (MBSE)

▸ MBSE has only been adopted on an "Ad-hoc" basis (aka "model-supported engineering")
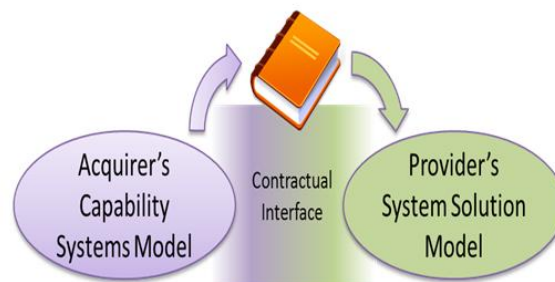
▸ Document-based knowledge transfer / traceability

Figure 1: Contractual Interface

▸

Assumptions

▸ Assuming that the Model-Based Acquisition is feasible and can be divided into the following phases:

▸ Model-Support Acquisition – Reflect current practices where models are used to support various engineering activities, including the production of key documents for contractual purposes.

▸ Model-Integrated Acquisition – Models form part of the contractual artefacts but as secondary or complementary artefacts.

▸ Model-Centric Acquisition – Models are the primary artefacts (with the capability to generate required documentation).

▸

Discussion – Part 1 (45mins)

▸ **Parallel Groups Discussion (1/2):**
- ▸ Qn 1. What classes of information in the Acquirer's Capability System Model should be disclosed to the Provider?
- ▸ Qn 2. What classes of information in the Provider's System Solution Model should be disclosed to the Acquirer?

▸ **Whole Group Discussion (1/2)**
- ▸ Report from each group for Qn1 and Qn2.
- ▸ Qn.3. How should the two models be interfaced?

5min Break!

Discussion - Part 2 (45 mins)

▸ **Parallel Groups Discussion (1/2):**
- ▸ Group 1:
  - ▸ Qn 4. Metamodels that could underpin items 1-3 ?
  - ▸ Qn 5. Model-based tender evaluation by the acquirer ?
- ▸ Group 2:
  - ▸ Qn 6. Model-based RFT evaluation by the provider

▸ **Whole-Group Discussion (1/2)**
- ▸ Report from each group for Qn 4, 5 and 6.
- ▸ Qn.7. What are the impediments to achieving the long term goal (i.e. Legal framework and IP issues)?

End!

Workshop Outcomes

- Phased approach discussed:

  - **Model-Support Acquisition** – Reflect current practices where models are used to support various engineering activities, including the production of key documents for contractual purposes.

  - **Model-Integrated Acquisition** – Models form part of the contractual artefacts but as secondary or complementary artefacts.

  - **Model-Centric Acquisition** – Models are the primary artefacts (with the capability to generate required documentation).

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Workshop Outcomes

- What classes of information in the Acquirer's Capability System Model should be disclosed to the Provider?
  - What <u>wouldn't</u> we pass across in model form?
    - Costing information, internal management information
    - Sensitive information (particularly prior to contract)
    - Information that does not make sense in a model
  - Functional model
    - Possible for iterative approach between government and industry
    - Issue of how approvals of model will take place vs a document-based approach
  - Rationale for performance figures and essential/desirable etc.
  - Standards
    - How to specify which details are relevant and testing against these
    - If conversion into model is sensible or useful
  - Support concept, test and evaluation information

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Workshop Outcomes

- **What classes of information in the Provider's System Solution Model should be disclosed to the Acquirer?**
  - What <u>wouldn't</u> be passed?
    - Lower-level detail risk and cost
  - System behaviour and Measures of Performance
  - Assumptions, rationales, applicable standards
  - Test plans and test cases
  - Technical forecast and resulting risks, Technical Integrity Risk
  - Support system model
  - Anything as specified by acquirer – when it makes sense to be in a model
  - IP might not be a problem at bid-time
    - Systems model should be abstract enough to avoid this
    - More detailed model would contain the IP information

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Workshop Outcomes

- **How should the two models be interfaced?**

- **Issues:**
  - Need a metamodel defined by government in order to answer this

  - Industry may or may not be able to deal with standards or tools, especially international bidders

  - Current interfacing standards lacking, these need to catch up before they can be mandated

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